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COMPOSITAE NEWSLETTER

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Charles Jeffrey, Editor, Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, U.K.

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BOOK REVIEW

THE BIOLOGY AND CHEMISTRY OF THE COMPOSITAE, edited by V.H. Heywood, J.B. Harborne and B.L. Turner, Academic Press, London, New York and San Francisco, £55. Pp. 1189 (in two volumes). 1977.

A brief account of ~~all~~ the genesis of this work was given in the last "Newsletter". In the opening chapter, the editors give a brief history of the taxonomy of the family, consider its variation in terms of adaptation to habitats and pollinators and review its chemistry in relation to its economic importance and the rôle of metabolites as chemical defence mechanisms. Turner gives an account of its meagre fossil history and its phytogeography, considering the family to be possibly mid-Cretaceous in origin and explaining its present distribution in terms of continental drift and rapid adaptive radiation from Miocene times onwards. Burtt relates much of the diversity observed in involucre, floret and fruit types to selective pressures involving pollination mechanisms, breeding systems, ovary protection, and seed dispersal. Leppik shows that the pattern of evolutionary modification of the capitulum in relation to the sensory perception of pollen vectors parallels that exhibited by single flowers. Jeffrey speculates on the possible evolutionary implications of the occurrence of the bilabiate corolla type. Stebbins evaluates the evolutionary significance of studies in comparative development and functional anatomy. It is unfortunate that he has chosen a taxonomically unsatisfactory _Senecio_ sensu lato on which to base in part his argument in favour of a shrubby ancestry for the _Compositae_, for as a result, the statements he makes with respect to the genus so circumscribed are without significance for the argument either way. No clear affinity with any other family is concluded from the admittedly equivocal evidence, and it is considered all the specializations of the _Compositae_ except for the gamopetalous corolla evolved independently of similar specializations in other families. Baagoe breaks interesting new ground in considering microcharacters of the ligule epidermis in relation to pollination biology and taxonomy; _Eriophyllum_ and _Arnica_ are helianthoid, not senecionoid, and _Calenduleae_ and _Arctotideae_ are heterogeneous. Further work is needed.

Pollen morphology in the *Compositae* and some postulated related families is reviewed in a long paper by Skvarla et al. Of the types of exine ultrastructure exhibited by the *Compositae*, only that designated anthemoid is approached by any of these other families, its common possession doubtless a plesiomorphy in the Hennigian sense. Anthemoid or modified anthemoid pollen is met within the *Cardueae*, *Mutisieae*, *Liabeae*, *Vernonieae* and *Lactuceae*, as well as the *Gorteriinae*, *Tarchonanthinae*, *Eriocephalus*, *Osmitopsis*, *Eriachaenium*, *Adenocaulon*, *Gymnarrhena* and the *Anthemideae* itself, while the apparently progressively more derived senecionoid and helianthoid types characterize the *Heliantheae*, *Helenieae*, *Eupatorieae*, *Calenduleae*, *Astereae*, *Inuleae* and *Senecioneae*, as well as *Centipeda*, *Elachanthus*, *Ceratogyne*, *Isoetopsis*, *Abrotanella*, *Ursinia* and, in modified form, the *Actotidinae* and *Catananche*. Solbrig shows that the chromosome cytology of about 1/3 of the family is known; even so, the sample is far from uniformly representative of all tribes and genera and other aspects of cytology are much more poorly known.

The abundance of secondary metabolites in *Compositae* is emphasized by Hegnauer, who discusses the distribution in the family of members of characteristic ubiquitous and other important classes of compounds. The sesquiterpene lactones are discussed in more detail by Herz, who emphasizes the significance for chemotaxonomy of knowledge of the biosynthetic relationships of compounds. The affinity of the *Eupatorieae*, *Heliantheae* and *Helenieae* is emphasized by their possession of heliangiolides, also recorded from *Peucephyllum*, while the possession of helianolides links *Arnica*, *Balduina*, *Baileya* and *Psilotrophe* with *Helenium* and *Gaillardia*; *Parthenium* and *Parthenice* show obvious affinity with the *Ambrosiinae*. Flavonoid variation, reviewed by Harborne, appears to have greater taxonomic significance at generic and lower than at tribal and subtribal levels. Rescorcinol-based chalcones and aurones are characteristic of *Coreopsidinae* and a few other members of the *Heliantheae* and *Helenieae*. The flavonoid syndrome of the *Compositae* is unlike that of any of the families postulated as closely related to it. Polyacetylenes (reviewed by Sorensen) occur in all tribes of the family and the ability to synthesize them is probably ancestral. While crepenynic acid derived polyacetylenes are also developed in *Pittosporaceae*, *Araliaceae*, *Umbelliferae* and *Campanulaceae*, in the *Compositae* they are characterized by the presence of cyclic, aromatic or heterocyclic end groups. Two distinct groups of tribes are the *Heliantheae* - *Helenieae* - *Inuleae* on the one hand, and the *Anthemideae* (except *Centipeda*) and *Astereae* on the other, although polyacetylenes are absent from some austral genera, e.g. *Vittadina*, *Minuria*, *Olearia*, *Celmisia*, eastern Australian *Brachycome*, and from *Elachanthus*, *Isoetopsis* and *Abrotanella*. Dithiin compounds are restricted to *Eupatorieae*, *Heliantheae* and *Helenieae*. Pharmaceutical and economic uses of the *Compositae* are considered by Wagner in the final general chapter; its economic potential is far from being fully exploited.

There follow tribal reviews, starting with an almost complete reworking of the taxonomy of the *Eupatorieae* by King and Robinson, very welcome in view of the very unsatisfactory generic treatment of Bentham and of the important weedy species in *Ageratina*, *Ageratum*, *Austroeupatorium*, *Ayapana*, *Chromolaena*, *Fleischmannia*, *Hebeclinum* and *Mikania*. *Isocarpha*, *Microspermum*, *Lepidesmia* and *Iltisia* are accepted into the tribe, *Adenostyles* (*Senecioneae*), *Dyscritothamnus*, *Marshallia* and *Palafoxia* (all *Heliantheae*) are not. The chemistry of the tribe, reviewed by Domínguez, has obvious taxonomic potential but is at present too little known.

The taxonomy of the *Vernonieae*, reviewed by Jones, is still in an unrevised state and our chemical knowledge of it, as shown by Harborne and Williams, is also very incomplete. There is some indication that most, if not all, of the Old-World species included now in such genera as *Vernonia* and *Centratherum* will prove eventually to be generically distinct from those of the New. The *Vernonieae* is now the least well known of all the tribes.

The *Astereae*, reviewed by Grau, are in little better taxonomic order. *Geissolepis* (perhaps *Heliantheae*) and *Isoetopsis* (perhaps *Inuleae*) are anomalous in the tribe in fruit structure, and *Abrotanella* is excluded. *Rhamphogyne* is is placed near *Apodocephala*, *Nannoglottis* near *Plagiocheilus* and *Ixiochlamys* is segregated from *Podocoma*. The chemistry of the tribe, reviewed by Herz, is little known; sesquiterpene lactones are uncommon and the polyacetylenes resemble those of *Anthemideae*.

A tentative arrangement of the *Inuleae* into three subtribes is proposed by Merxmüller, Leins and Roessler. *Anisochaeta* and *Feddea* are accepted but *Symphyllocarpus* (? *Anthemideae*), *Gymnarrhena* (? *Anthemideae*), *Tugarinovia* (surely *Cardueae*), *Dimeresia* (*Heliantheae*), *Osmitopsis* (*Anthemideae*), the *Tarchonanthinae* (probably *Anthemideae*), *Heterolepis* (? *Arctotideae*), *Adenocaulon* and *Eriachaenium* (both *Mutisieae*) are excluded, mainly on palynological grounds. The generic chaos of the *Gnaphalium* - *Helichrysum* complex is duly acknowledged. The chemistry, reviewed by Harborne, shows promise but little is known in detail and even why some *Anaphalis* and *Helichrysum* species smell of curry is left chemically unexplained.

The review of the *Heliantheae* by Steussy shows signs of hasty preparation; *Hymenostephium* is referred both to *Verbesinae* group 3 and *Helianthinae* group 1, n = 54 and (correctly) 45 are both quoted for *Fitchia*, and *Melanthera* is not recorded as present in the Old World as well as the New (although the Old-World species are perhaps nearer to *Lipochaeta* than to typical New-World *Melanthera*). Nevertheless, the new systematy is welcome, like all such hypotheses a stimulus to further work. *Trichospira* is removed to *Vernonieae*, as is *Philoglossa* (properly *Liabeae*). *Microlecane*, *Coreopsis* and *Cosmos* are maintained distinct from *Bidens* without comment. Other points to be queried are the reference of *Marshallia* to the *Eupatorieae*, of *Geissolepis* to the *Astereae*, the acceptance of *Isocarpha* into the *Galinsoginae*, and the placing of a group of genera (*Heptanthus*, *Dilepis* (= *Flaveria*), *Coulterella* (= *Flaveria*) and *Tetranthus*) into the *Senecioneae*, where they appear distinctly out of place. Swain and Williams review the chemistry. Sesquiterpene lactones are confined, as far as is known, to *Melampodiinae*, *Bahiinae* and *Ambrosiinae*; chalcones and aurones are known in *Viguiera* and *Lasthenia* as well as the *Coreopsidinae*. *Guizotia* appears out of place in the *Coreopsidinae*; by the presence of thioethers, it would be better referred to *Ecliptinae* near *Eclipta* and *Wedelia*. The wholly enigmatic *Sheareria* is admitted with reservation.

Turner and Powell review and dismember the *Helenieae*. Some of their proposals can be hardly disputed; such are the reference of *Olivaea*, *Rigiopappus* and *Thurovia* to *Astereae*, *Microspermum* and *Iltisia* to *Eupatorieae*, and of various groups to the *Heliantheae* - *Neurolaeninae*, *Varillinae* (included in *Neurolaeninae* by Steussy), *Gaillardinae* (accepted by Steussy), *Bahiinae* (accepted by Steussy, including *Florestina*), *Psilotrophinae* and *Hymenopappinae* (included in *Gaillardiinae* and *Bahiinae* respectively by Steussy). The placing of *Palafoxia* (with *Marshallia*) in the *Eupatorieae* is more doubtful, while *Thymopsis* is accepted into the *Bahiinae* by Steussy. The *Jaumeinae* of these authors is heterogenous and its placement in *Coreopsidinae* (newly elevated to tribal rank by them) is likewise dubious. The major controversy lies, however, in the reference of a number of groups to the *Senecioneae* into which, with the exception of the *Blennospermatinae* with some reservation, they are not accepted by Nordenstam. The chemical review by Bohm provides some guidance. 1, 10-seco-eudesmanolides are known in *Eriophyllum*, which, like *Chaenactis*, *Bahia* and *Venegasia*, also makes germacranolides. Anthochlors are recorded in *Lasthenia* and *Syntrichopappus*. *Chaenactis* and *Eriophyllum* have disulphated polyacetylenes, as do *Palafoxia* and *Schkuria*, while *Schkuria* and *Lasthenia* have polyacetylenes of the ene-tetrayne-ene system, like most of the *Coreopsidinae*. *Flaveria* and *Lasthenia* have thiophenes similar to those in *Tagetes*, but *thiophenes* have not been found in *Hypericophyllum*. Sulphated flavonoids are found in *Lasthenia*, *Flaveria* and *Sartwellia*. *Flaveria* resembles *Pectis* and a group of closely related genera in the *Coreopsidinae* in elaborating a Kranz syndrome (C4) photosynthetic pathway. In short, what is known of the chemistry of those genera that Turner and Powell would refer to the *Senecioneae* shows that they have a typically helianthoid chemical facies; there is no trace of the senecionoid eremophilanes and alkaloids so characteristic of that tribe. *Arnicinae* (including *Peucephyllum*) are closely related to the *Gaillardiinae*; *Chaenactidinae*, *Eriophyllinae* (perhaps heterogenous) and possibly *Crocidium* and *Blennosperma* appear to fit between the *Bahiinae* and *Coreopsidinae* in Steussy's system, and the *Peritylinae*, *Flaveriinae* and *Jaumeinae* (in part) between the *Gaillardiinae* and *Coreopsidinae*; the affinity of *Welwitschiella* (? vernonioid) is unknown. *Cadiscus* (like *Doronicum*) is truly senecionoid. The *Tagetinae* are reviewed as a tribe (*Tageteae*) by Strother, who provides a useful key to the genera. Morphologically and chemically (as shown by Rodriguez and Mabry) they fall within the helianthoid ambit, near to *Flaveriinae*, *Jaumeinae* and *Coreopsidinae*.

Nordenstam reviews the *Liabeae* and *Senecioneae*, the former receiving the tribal characterization and recognition it has long warranted. From the latter he correctly excludes *Arnica* and various related helianthoid genera. In the *Blennospermatinae*, he includes *Ischnea* and *Abrotanella* as well as *Crocidium* and *Blennosperma*; the latter two appear to have little affinity with the former two. *Ischnea* is probably asteroid, near *Brachycome*, *Abrotanella* is perhaps a reduced inuloid; it has kaurene diterpenoids, which are more typical of *Heliantheae*, although also recorded in *Eupatorieae* and in *Bedfordia* of the *Senecioneae*. Robins's review of the chemistry emphasizes the taxonomic isolation of the true *Senecioneae*.

Heywood and Humphries show in the *Anthemideae* a tribe in which progress towards a satisfactory taxonomy is steadily being made, both morphology and chemistry (reviewed by Greger) making useful contributions. Excluded from the tribe are *Polygyne* (*Heliantheae*), *Ceratogyne* (referred to the *Inuleae* but perhaps better in *Astereae*, near *Brachycome*), *Plagiocheilus* (*Astereae* near *Lagenophora* and *Solenogyne*), *Abrotanella*, *Ischnea* and *Centipeda* (probably *Inuleae*, near *Carpesium*). *Elachanthus* and *Dimorphocoma* are accepted without comment, though they may be asteroid, of *Minuria* affinity. *Osmitopsis* and *Ursinia* are accepted with reservation. *Centipeda* contains the common pentaynene, which has otherwise never been found in *Astereae* or *Anthemideae*. Formal subtribes are not established, but a number of informal groups is recognized. The southern hemisphere genera appear to fall into two groups, the cotuloid with characteristic anthemoid acetylenes, e.g. *Cotula*, *Soliva*, *Hippia*, *Eriocephalus*, *Sphaeroclinium*, *Adenanthemum*, *Cymbopappus*, *Leucoptera*, *Adenoglossa*, *Peyrousia*, *Lidbeckia*, *Thamniphyllum*, *Inezia* and *Pentzia* and an ursinioid, devoid of acetylenes but with characteristic benzofurans, including *Ursinia*, *Lasiospermum*, *Phyrmaspermum*, *Asaemia*, *Eumorphia*, *Athanasia*, *Stilpnophytum* and *Gymnopentzia*, all confined to Africa. The *Tarchonanthinae* are not considered but may be related through *Eriocephalus* to the cotuloid group, as may be also *Osmitopsis*. *Symphyllocarpus* and *Gymnarrhena* should also be considered as possibly anthemoid.

The systematics and chemistry of the two unrelated tribes *Calenduleae* and *Arctotideae* are reviewed by Norlindh and Valadon respectively. Our knowledge of both tribes is inadequate in both respects. The *Arctotideae* are taken to include four well-marked subtribes, including *Eremothamninae* which fits easily into this geographically circumscribed but morphologically diverse assemblage. *Platycarpha* (probably *Mutisieae*) is excluded, *Heterolepis* is not considered.

The *Calenduleae* are likewise geographically natural but unlike the *Arctotideae* are (except for *Dipterocome* and *Garuleum*) also morphologically uniform. Present generic concepts are based almost entirely on achene characters and need revision. Chemical (presence of dimorphocoelic acid) and morphological (ligule microcharacters) evidence favours the unification of *Dimorphotheca*, *Castalis* and *Osteospermum* sect. *Blaxium* into a distinct taxon, for which generic rank would seem appropriate.

Dittrich divides the traditional *Cardueae* into three distinct tribes, *Echinopeae*, *Carlineae* and *Cardueae* sensu stricto (with *Carduinae* and *Centaureinae*), but Wagner's review of the chemistry, while supporting this taxonomic division, reveals no differences emphatic enough to warrant more than subtribal ranking for these four taxa. As a single tribe, they are certainly more homogeneous than, e.g., *Heliantheae*, *Arctotideae* and *Mutisieae*. Excluded are *Cavea* (referred to the *Inuleae* but surely near to *Saussurea*) and *Wariona* (to *Mutisieae*) as well as *Gundelia* (arctotoid) and *Platycarpha* (probably *Mutisieae*, of *Erythrocephalum* affinity); *Berardia* is accepted from *Mutisieae*.

The *Mutisieae* themselves are reviewed by Cabrera, being, like the *Liabeae*, too little known chemically to merit a chemical review. Of the four subtribes, the *Barnadesiinae* and *Nassauviinae* are well-defined and homogeneous, the *Gochnatiinae* and *Mutisiinae* heterogenous and needing taxonomic elucidation. The key to the subtribes on p. 1041 has suffered disastrously in the type-setting; the first line of the second lead in couplet B should read "Corollas mostly glabrous. Pappus of simple bristles (or villous paleae in ......" *Chionopappus* (*Liabeae*) is excluded).

Closing the tribal reviews are those by Tomb (systematics) and Gonzalez (chemistry) of the *Lactuceae*. The tribe has been little studied chemically and generic boundaries in the *Lactuca* - *Prenanthes* complex are still uncertain. The important paper by P.D. Sell, "Taxonomic and nomenclatural notes on the *Compositae* subfam. *Cichorioideae*", in Bot. J. Linn. Soc. 71: 236-266 (1976) should be added to the systematic references.

Mabry and Bohlmann summarize the chemistry, Turner the biology, in the closing chapters. Chemically, the *Compositae* are placed in direct relationship to the *Umbelliferae* and *Campanulaceae*, being linked to both by the sesquiterpene lactone and acetylene chemistry, to the former by the coumarins and the latter by inulin accumulation. The *Calyceraceae* have no acetylenes and contain seco-iridoids and are therefore placed remote; but perhaps the presence of this latter class of compounds has been over-weighted taxonomically, and they do occur in the other inulin-containing group, the *Goodeniaceae* - *Brunoniaceae* alliance. Chemically, the tribes relate more to one another than to any other family, even the *Lactuceae* and *Senecioneae* which are most distinct chemically. A very useful alphabetical list of accepted genera (and some synonyms), with the tribal allocation of each, followed by subject, organism and chemical compound indexes, completes the work.

In view of the vast amount of new information that has accrued during the past 20 years, it is remarkable that the tribal concepts of Cronquist are nearly wholly supported by the data here presented. Of other groups accorded tribal rank, both before and since, only the *Liabeae* remain supported as a distinct taxon at this level. Of the groupings of the tribes, that of Wagenitz receives most support. The subfamily *Cichorioideae* includes the tribes in which the plesiomorphous anthemoid pollen type preponderates and in which the sesquiterpene lactones are confined to the germacranolide, elemanolide, guaniolide and eudesmanolide structural classes; these are the *Lactuceae*, *Mutisieae*, *Vernonieae*, *Liabeae*, *Cardueae* (including *Echinopeae* and *Carlineae*) and *Arctotideae* (including *Eremothamneae*). The subfamily *Asteroideae*, on the other hand, commonly exhibits the more derived senecionoid and helianthoid pollen types and, in the more advanced tribes, development of biogenetically more advanced sesquiterpene lactone structural classes; *Anthemideae* (including *Tarchonanthinae*, *Cotulae* and *Ursinieae*) have mostly anthemoid pollen, heliangiolides and ene-tetrayne-ene type acetylenes; *Astereae* share the latter but are depauperate in sesquiterpenes and have helianthoid pollen; the *Calenduleae* resemble the *Astereae* in the latter respect but have pentaynenes; advanced sesquiterpene lactone classes characterize some members of the *Inuleae*, *Heliantheae* (including *Helenieae*, *Coreopsideae* and *Tageteae*) and, to a lesser extent, *Eupatorieae*; the last two tribes are also linked closely by the development of phytomelanins, helianthoid type pollen and similar floral epidermis features; finally, the *Senecioneae* have distinct eremophilane type sesquiterpene lactones and pyrrolizidine alkaloids, the latter known otherwise (albeit with different necic acid moities) only in the *Eupatorieae*.

C. JEFFREY

ARTICLE

NOTES ON THE EVOLUTION OF COMPOSITAE

B.L. Burtt

(Royal Botanic Garden, Edinburgh)

Self-incompatibility is widespread in *Compositae* and may well have been a basic feature of the family since its inception. There thus seems to be little reason for the differentiation of peripheral flowers that have only a female function. This problem puzzled me when I spoke at the Reading Symposium in July 1975 (Burtt, 1977). Female rays, by opening first, render the capitulum protogynous and may contribute to cross-pollination in self-compatible plants, for the stigmata are receptive before the pollen of the disc flowers is shed. But this is clearly a secondary advantage if *Compositae* are primarily self-incompatible.

In September 1976, at the IAPT Symposium at Hamburg, Dr. G. Gottsberger gave a stimulating paper on pollination by beetles, which is widely believed to be the primitive form of zoophily in angiosperms. He pointed out that the beetles are an old and numerous group that have always been present in the history of angiosperms. The primitive angiosperms may well have been beetle-pollinated, although the cantharophily now seen in many plants undoubtedly represents a secondary recurrence of this mode of pollination. Gottsberger made one observation that is of great importance in the context of the evolution of *Compositae*. He pointed out the close correlation between cantharophily and protogyny. The reason, he believes, is that unlike other pollen-vectors beetles are long-term visitors to flowers; if they are to be effective agents of cross-pollination they need to wipe the foreign pollen from their bodies on to a receptive stigma on arrival at a flower; otherwise the foreign pollen will soon be swamped by that of the flower (or capitulum) itself (Gottsberger, 1977).

As already noted, female ray flowers confer effective protogyny on the capitulum, and amongst the basic tribes of *Compositae* they are particularly characteristic of the yellow-flowered *Heliantheae* and related tribes, which are often beetle-pollinated. It is thus a reasonable hypothesis that female rays evolved in relation to cantharophily. The fact that the ray flowers have become male-sterile is not, of itself, of any functional importance; it follows from the fact that the floral mechanism of *Compositae* does not easily permit protogyny in an individual flower.

The above hypothesis gives an answer to the question 'Why are the capitula of some *Compositae* protogynous?'. The answer to the question 'Why are the rays of some self-incompatible *Compositae* female?' is simply 'because it confers functional protogyny on the capitulum'. It is not the primary question.

A corollary of this hypothesis should be that self-incompatible members of non-cantharophilous genera do not develop female rays. Without cantharophily the peripheral differentiation of a semaphyll should retain the bisexual nature of the flower or lead to a neuter flower. This is what we find: hermaphrodite peripheral flowers in, for example, *Stokesia* (*Vernonieae*) and *Mutisia* (*Mutiseae*), sterile radiant flowers in *Centaurea* (*Cardueae*).

The other stimulus to thought on *Compositae*, since I wrote the paper for the Reading Symposium, has been that delivered at the same meeting by C. Jeffrey on the evolution of corolla types in the family (Jeffrey, 1977). Jeffrey put forward the unorthodox view that the bilabiate corolla of *Mutiseae* is the basic type in *Compositae*, and that it has been derived from an ancestor bearing zygomorphic flowers in an elongate raceme. Although I have come to disagree with this view, it has made me think more thoroughly about relative primitiveness among the tribes of *Compositae*, a matter I had previously tended to dismiss as unprofitable speculation.

The thoughts that now come to my mind are these. In the first place zygomorphic flowers in an elongate raceme would almost certainly have reached the stage of having numerous ovules and a more or less specialized pollination mechanism. They would have embarked on what I have called (Burtt 1961, p. 228) the individualist path, where a flower produces a large amount of seed from a single successful act of pollination, often by a specialized pollinator. *Compositae* belong to the other main trend, the collectivists: there is an agglomeration of small one-seeded flowers, so that each seed requires a separate act of pollination, but pollinators are generalised. Now I do not deny for a moment that there are often deviants from a main evolutionary trend, or that there are such deviants from the individualist to the collectivist path. One has only to recall the congested bi- or uni-ovulate flowers of *Selagineae* and *Globularieae* in *Scrophulariaceae*. Nevertheless, these are restricted groups of limited scope. In seeking the origins of *Compositae* we are seeking a group that could have advanced towards the capitulum on a broad front. I find it difficult to conceive a selection pressure that would have induced the sharp diversion of a large group of individualists on to a collectivist path.

The pattern of changes shown in Jeffrey's diagram of corolla-forms is very much more plausible than that involved in a scheme of Composite phylogeny that starts with Heliantheae alone. Nevertheless it assigns a derived status to the most widely spread type: the 5-lobed tubular corolla of many hermaphrodite flowers.

Since an elongate raceme will tend to have multi-ovulate zygomorphic flowers, it is, in my view, simpler to look for Composite origins in a corymbose raceme. In such an inflorescence the flowers remain erect and regular, but with a tendency, enhanced as the inflorescence becomes more compact, to peripheral differentiation (cf. Iberis in Cruciferae, for example).

At the Reading Symposium, Leppik (1977) restated his thesis that, in the organization of the capitulum, the Compositae have passed through the same series of anthecological stages that he had previously recognized in the evolution of the form of individual flowers. However, Leppik's sequence in regard to the flowers of early angiosperms had as its central thesis the idea that the floral forms evolved in correlation with the sensory powers of the available pollinators that were themselves evolving alongside. It was a co-evolutionary sequence. Compositae are a highly evolved family and it must be almost certain that the whole range of potential pollen-vectors was already in existence when the first recognizable Compositae appeared. There was thus no co-evolutionary sequence and no obvious reason why capitular forms should evolve in sequence rather than as an explosion of direct adaptive radiation towards the whole range of pollinators.

There are four fundamental patterns in Compositae: (a) a head of anthocyanic, relatively long, tubular corollas (Vernonieae etc.); (b) the liguliflorous head (Lactuceae); (c) the radiate head, with 3-toothed rays and 5-lobed disc (Heliantheae, Senecioneae etc.), often reduced to a discoid head by loss of rays; (d) the head of bilabiate flowers (Mutiseae).

It is one of the striking taxonomic facts about Compositae that, despite the uniformity of the family, the divisions between the major tribes are deep and the number of "intermediate" genera remarkably few. This is just the situation that would be expected if there had been an early explosive diversification connected with the evolution of the different capitular types when this virtually new floral organization of high potential interacted with the wide range of potential pollinators.

References

Burtt, B.L., 1961. Compositae and the study of functional evolution. Trans. Bot. Soc. Edinb. 39: 216-232.

————————, 1977. Aspects of diversification in the capitulum. In Biology and Chemistry of Compositae: ed. Heywood, Harbourne & Turner 1: 41-59.

Göttsberger, G., 1977. Some aspects of beetle pollination in the evolution of flowering plants. In Flowering Plants: evolution and classification of higher categories: ed. K. Kubitski. Plant Syst. & Evol. Suppl. 1: 211-226.

Jeffrey, C., 1977. Corolla forms in Compositae - some evolutionary and taxonomic speculations. In Biology and Chemistry of Compositae: ed. Heywood, Harbourne & Turner 1: 111-118.

Leppik, E.E., 1977. The evolution of capitulum types of the Compositae in the light of insect - flower interaction. In Biology and Chemistry of Compositae: ed. Heywood, Harbourne & Turner 1: 61-89.

NEWS FROM INDIVIDUALS/REQUESTS FOR MATERIAL

CURTIS CLARK, Department of Botany, University of California, Davis, California 95616, U.S.A. RESEARCH: Experimental systematic study of *Encelia* with D.W. Kyhos, experimental systematic study of *Eschscholzia* (Papaveraceae), investigation of UV floral patterns in *Compositae* and other families. TRAVEL: Deserts of California, Arizona, Sonora, Baja California, Baja California Sur, Spring 1978 and 1979, collecting *Encelia* and relatives.

DONALD W. KYHOS and CURTIS CLARK, Department of Botany, University of California, Davis, California 95616, U.S.A., would be grateful for viable achenes of *Encelia*, *Enceliopsis* and *Geraea* and especially of *Encelia scaposa* (Texas, New Mexico), *Encelia linearis* (Nayarit), *Encelia hispida* (Galapagos), *Encelia halimifolia* (Sonora, Baja California Sur), *Verbesina angustissima* (Nayarit), *Verbesina virgata* (Central Mexico), *Encelia ravenii* (Baja California) and *Geraea viscida* (California, Baja California). Any quantity greater than two is adequate.

DR. W. DENNIS CLARK, Department of Botany and Microbiology, Arizona State University, Tempe, Arizona 85281, U.S.A., is working on the systematics of *Haplopappus* section *Haplopappus* of South America. Dennis R. Bischoff, a student of Dr. Clark, is currently doing systematic research on *Isocoma* Nutt. Gregory K. Brown, a student of Dr. D.J. Pinkava and Dr. Clark, has completed a biosystematic study of *Platyschkuhria* Rydb. and is currently working on South American *Haplopappus*. Dr. Clark, Dr. Pinkava, Dr. D.J. Keil (Department of Biological Sciences, California Polytechnic Institute, San Luis Obispo, California 93407, U.S.A.) and Dr. R.A. Mayes (Department of Biological Sciences, Virginia Polytechnic Institute, Blacksburg, Virginia 20550, U.S.A.) have recently completed a study on the origin of *Hymenothrix loomisii* Blake.

DAVID R. GIVEN, Botany Division, DSIR, Private Bag, Christchurch, New Zealand. RESEARCH: Taxonomy of introduced *Compositae* in NZ botanical region; taxonomy of *Compositae* tribe *Astereae* in Australasia especially *Celmisia*, *Olearia* and derivative genera; relationships between South American and Australasian Erigeroid genera; floret trichomes and classification. N.Z. Journal Botany 11: 786-96 (1973); loc. cit. 13: 547-56 (1975); loc. cit. 17: - in press (1979). REQUESTS FOR MATERIAL: Authentic floral material of *Compositae* tribe *Astereae* (worldwide).

DR. WALTER A. KELLY, School of Natural Sciences, Mesa College, Grand Junction, Colorado 81501, U.S.A., is currently starting a research programme on *Agoseris*.

DR. JOHN C. MITCHELL, Dermatology Laboratory, Shaughnessy Hospital, 4500 Oak Street, Vancouver, British Columbia V6H 3N1, Canada, announces the publication of Mitchell, J., & Rook, A., *Botanical Dermatology*, Greengrass Ltd., 691 W. 28th Avenue, Vancouver, British Columbia V5H 2H4, Canada; 800 pp. approx., publ. January 1979. Price $28 (US) until 31.12.78., £31.95p. after 31.12.1978. Has material of chemotaxonomic interest concerning *Compositae*, plant products and compounds irritant, toxic and allergenic for the human skin, eye and respiratory tract.

PRITHIPALSINGH, Deshbandhu College, University of Delhi, Kalkaji, New Delhi 110019, India, reports recent publications:

DAKSHINI, K.M.M. and PRITHIPALSINGH, 1977. Numerical Taxonomy of the genus *Blumea* DC. (Asteraceae - Inuleae) in India. Phytomorphology 27: 247-260.

DAKSHINI, K.M.M. and PRITHIPALSINGH, 1978. Section Hieraciifoliae Rand. of the genus *Blumea* DC. (Asteraceae - Inuleae). Taxon 27: 21-25.

PRITHIPALSINGH and DAKSHINI, K.M.M., 1977. Structural variations in the style and pollen presentation mechanisms in the genus *Blumea* in India. Bot. Mag. (Tokyo) 90: 291-299.

PRITHIPALSINGH and DAKSHINI, K.M.M., 1977. Chemotaxonomic studies on the genus *Blumea* DC. (Asteraceae - Inuleae) in India. Acta Bot. Indica 5: 143-159.

T. PULLAIAH, Department of Botany, Andhra University, Waltair 530003, A.P., India. RESEARCH: Embryology and systematics of *Compositae*, *Melampodium*, *Carthumus*, *Astereae*, *Vernonieae*, *Senecioneae*. Phytomorphology 26: 77-86 (1976); Botanique (Nagpur) 7: 63-70 (1976); Acta Bot. Indica 5 (1977). Mature viable achenes of any species of *Helenieae* requested.

G. THANIKAIMONI, Institut Francais, B.P. 33, Pondicherry 605001, India, reports the recent work of Miss Vasanthy George of the same Institute:

VASANTHY, G. Structure et terminologie de la paroi sporo-pollinique; Asteraceae: *Vernonia* and *Centratherum* - APLF Documents pour la réunion du groupe de travail morphologie sporopollinique et numériclature, p. 44-48, 6-7 Octobre (1975), Paris. See also Prof. Straka's comment on it and Vasanthy's reply in Bulletin de la Société Botanique de France 122: 39 & 56 (1975).

VASANTHY, G. Pollen of the South Indian hills. Trav. Sect. Sci. Tech. Inst. Fr. Pondichéry, XV, 74 p. 36 planches photo, with English version (1976) - Morphological description, key and photomicrographs of pollen of *Centratherum courtallense*, *Vernonia conyzoides*, *V. ? fysoni* and *V. peninsularis* in p. 17-20, 41, 50 & 51 and pl. VII & IX.

VASANTHY, G. Complexities of aperture, columella and tectum. Proceedings of IV IPC (1976-77) in press; see also IV IPC Abstracts, 1976. pp. 189-190. - Aperture complexities in *Pavetta*, *Moonia* and *Senecio* and Columellartectal complexities in *Teucrium*, *Dipsacus*, *Vernonia* (13 spp.) *Centratherum* (6 spp.).

ANNETTE WIKLUND, Botaniska Institutionen, Lilla Frescati, 104 05 Stockholm 50, Sweden, is undertaking a taxonomic revision of the Mediterranean group of genera *Asteriscus* s.l., *Pallenis* and *Rhanterium*.

RECENT LITERATURE

These references have been abstracted from the Current Awareness Lists of the Library, Royal Botanic Gardens, Kew. A comprehensive bibliography of Compositae, published annually, is contained in the Kew Record of Taxonomic Literature.

For explanation of the significance (geographical) of the numbers at the lower left of each citation, see Newsletter No. 6.

GENERAL

Abbà, G.
La diffusione dei generi "Ambrosia" e "Galinsoga" (Asteraceae) in Piemonte e in Valle d'Aosta. (The spreading of the genera "Ambrosia" and "Galinsoga" (Asteraceae) in Piedmont and in the Aosta Valley). Inform. Bot. Ital.,
1 9(3): 289-290 (1977) - (En).

Anon.
Recent literature. Compositae Newsl., no. 6: 12-30 (1978). References on Compositae taken from the Current Awareness List,
1-7 Library, RBG, Kew.

Badillo, V.M.
Tres Compuestas de Venezuela. Acta Bot. Venezuel., 13(1-4): 109-115 (1978) - Illus. Montanoa angulata, Lourteigia fimbriata, Elephantopus
4 hirtiflorus.

Hilliard, O.M.
The geographical distribution of Compositae native to Natal. Notes Roy. Bot. Gard. Edinburgh, 36(2): 407-425
5 (1978) - Map.

Robinson, H.
An analysis of the characters and relationships of the tribes Eupatorieae and Vernonieae (Asteraceae). Syst. Bot., 2(3): 199-208 (1977 publ. 1978)
1-7 - Illus.

Mears, J.A.
Types of Asteraceae at the Philadelphia Academy of Natural Sciences (P.H.): part 5. Segregated types and selected authentic material of Astereae and Inuleae. Compositae Newsl., no. 6: 2-6
1-7 (1978).

Morris, D.I.
Miscellaneous notes on endemic Tasmanian plants in the genera Olearia, Ixodia. Rec. Queen Victoria Mus. (Tasmania), no. 55.
7 5p. (1977) - Chrom. no.

VERNONIEAE

Robinson, H.
See under - GENERAL.

EUPATORIEAE

Bohlmann, F., Mahanta, P.K., Natu, A.A., King, R.M. and Robinson, H.
New germacranolides from Isocarpha species. Phytochemistry,
4 17(3): 471-474 (1978).

Bohlmann, F., Suwita, A.,and Mabry, T.J.
New labdane derivatives and further constituents of Brickellia species. Phytochemistry, 17(4):
3,4 763-765 (1978).

King, R.M. and Robinson, H.
Guayania davidsei and
Hebeclinium gentryi, new
species from northern South
America (Eupatorieae -
Asteraceae). Ann. Missouri
Bot. Gard., 64(2): 366-370
(1977 publ. 1978) - Illus.
4 Guyania.

King, R.M. and Robinson, H.
Studies in the Eupatorieae
(Asteraceae): 168. Additions
to the genus Ageratina.
Phytologia, 38(4): 323-355
(1978) - Illus., chrom. nos.
4 key.

King, R.M. and Robinson, H.
Studies in the Eupatorieae
(Asteraceae): 169. Two new
species of Fleischmannia from
Guatemala. Phytologia, 38(5):
4 417-423 (1978) - Illus.

King, R.M. and Robinson, H.
Studies in the Eupatorieae
(Asteraceae): 170. Additions
to the genus Neocabreria.
Phytologia, 38(5): 424-428
4 (1978) - Illus., key.

King, R.M. and Robinson, H.
Studies in the Eupatorieae
(Asteraceae): 171. A new
genus, Corethamnium.
Phytologia, 39(1): 54-57
4 (1978) - Illus.

King, R.M. and Robinson, H.
Studies in the Eupatorieae
(Asteraceae): 172. A new
genus, Castenedia.
Phytologia, 39(1): 58-60
4 (1978) - Illus.

King, R.M. and Robinson, H.
Studies in the Eupatorieae
(Asteraceae): 181. Two new
species of Trichogonia.
Phytologia, 39(5): 334-338
4 (1978) - Illus.

King, R.M. and Robinson, H.
Studies in the Eupatorieae
(Asteraceae): 182. A new
genus, Bishovia. Phytologia,
4 39(5): 339-342 (1978) - Illus.

Matzenbacher, N.I.
Uma nova combinação no
gênero Mikania Willd.
(Compositae). Bradea, 2(37):
4 258-259 (1978) - (En).

Robinson, H.
See under GENERAL.

ASTEREAE

Anderson, L.C.
Studies on Bigelowia
(Asteraceae): 3. Cytotaxonomy
and biogeography. Syst. Bot.,
2(3): 209-218 (1977 publ. 1978)
3,4 - Maps, chrom. nos.

Anderson, L.C.
New taxa in Chrysothamnus,
section Nauseosi (Asteraceae).
Phytologia, 38(4): 309-320 (1978)
3 - Illus., map, chrom. nos.

Clark, W.D. and Mabry, T.J.
Systematic implications of
flavonoids in Hazardia.
Biochem. Syst. Ecol., 6(1):
3 19-20 (1978) - Chrom. nos.

Carter, C.R.
The cytology of Brachycome: 8.
The inheritance, frequency and
distribution of B chromosomes
in B. dichromosomatica (n = 2),
formerly included in B. linearifolia.
Chromosoma, 67(2):
109-121 (1978) - Illus., map,
7 chrom. nos.

Hobhouse, P.
Olearias. Garden (London),
103(6): 229-234 (1978) - (En);
7 col. illus.

Jones, A.G.
Observations on reproduction
and phenology in some perennial
Asters. Amer. Midl. Nat., 99(1):
3 184-197 (1978) - Map.

Speirs, D.C.
The genus *Townsendia* in western Canada. *Quart. Bull. Alp. Gard. Soc.*, 46(2): 167-168 (1978). 3

Semple, J.C.
The cytogeography of *Aster pilosus* (Compositae): Ontario and the adjacent United States. *Canad. J. Bot.*, 56(10): 1274-1279 (1978) - (Fr); Illus., map, chrom. nos. 3

Stucky, J.
Hybridization between *Aster* and *Machaeranthera* and its taxonomic significance. *Amer. J. Bot.*, 65(2): 125-133 (1978) - Illus., chrom. nos. 3,4

INULEAE

Brummitt, R.K.
Report of the Committee for Spermatophyta, 20: Proposal 403. 9050 *Relhania* L'Héritier (1789) (Compositae) vs *Osmites* Linnaeus (1764). *Taxon*, 27(2/3): 285-289 (1978). 5

Capineri, R., D'Amato, G. and Marchi, P.
Nuclear and reproductive characters in the Italian taxa of *Asteriscus* Mill. (incl. *Pallenis* Cass.) (Compositae). In OPTIMA Second Meeting, Firenze (Italy) 23-29 May 1977. Abstracts ...: [1]p. (1977). Abstract only. 1

Georgiadou, E.E.
Three new species of *Anaphalis* (Compositae) from "Flora Iranica" area. (Trois nouvelles espèces d'*Anaphalis* (Compositae) dans l'aire de la "Flora Iranica"). *Candollea*, 33(1): 135-138 (1978) - (Fr). 2,6

Kitamura, S.
La correspondance du Muséum national d'histoire naturelle, Paris. *Acta Phytotax Geobot.*, 53(5): 129-130 (1978) - (Ja); *Gnaphalium*. 2,6

Koyama, H.
On a new name of *Gnaphalium* from Falkland Islands. *Acta Phytotax Geobot.*, 53(5): 84 (1978). 4

Mathew, A. and Mathew, P.M.
Studies on South Indian Compositae: cytology of the genus *Blumea* DC. *Cytologia* 40(2): 365-370 (1975) - Illus., chrom. nos. 6

Namur, C. de, and Verlaque, R.
Contribution à l'étude biogéographique du genre *Helichrysum* Miller. *Biol. Ecol. Médit.*, 3(2): 17-22 (1976) - (En); map, chrom. nos. 1,2, 5-7

Nogueira, I.
The genus *Stoebe* (Compositae) in the *Flora Zambesiaca* area and Angola. *Bol. Soc. Brot.*, 51: 127-133 (1977) - Illus. 5

Ovdienko, O.A., Litvinenko, V.I. and Shreter, A.I.
Kolichestvenno-sistematicheskoe izuchenie Krymsko-Kavkazskikh vidov roda *Helichrysum*. (A quantitative taxonomic study of the Crimean - Caucasian species of the genus *Helichrysum*). *Byull. Mosk. Obshch. Ispyt. Prir., Biol.*, 82(6): 74-87 (1977) - (En). 1,2

Prithipalsingh and Dakshini, K.M.M.
Chemotaxonomic studies on the genus *Blumea* DC. (Asteraceae - Inuleae) in India. *Acta Bot. Indica*, 5(2): 143-159 (1977). 6

HELIANTHEAE

Anashchenko, A.V.
Sovremennye voprosy prikladnoi botaniki, genetiki i selektsii podsolnechnika. *Byull. Vses. Ord. Lenina Inst. Rast. N.I. Vavilova*, 69: 47-51 (1977). *Helianthus*. 1-7

Burton, R.M.
Bidens connata. *B.S.B.I. News*, no. 18: 15-16 (1978) - (En); Illus. Recorded in Britain. 1

Butler, M.G. and Weedon, R.R.
Chromosome analysis of *Bidens coronata* (Compositae). *Canad. J. Genet. Cytol.*, 20(1): 147-149 (1978). Illus., chrom. nos. 3

Canne, J.M.
Circumscription and generic relationships of *Galinsoga* (Compositae: Heliantheae). *Madroño*, 25(2): 81-88 (1978) - Chrom. nos., keys. 4

Fay, J.J.
Revision of *Perymenium* (Asteraceae - Heliantheae) in Mexico and Central America. *Allertonia*, 1(4): 235-296 (1978) - Illus., chrom. nos., keys. 4

Hart, C.R.
A new species of *Bidens* (Compositae) from Mexico. *Brittonia*, 30(2): 289-292 (1978) - Illus., chrom. no. 4

Horner, H.T., jr. and Pearson, C.B.
Pollen wall and aperture development in *Helianthus annuus* (Compositae: Heliantheae). *Amer. J. Bot.*, 65(3): 293-309 (1978) - Illus. 1-7

Jeffrey, C.
Helianthus annuus. *Curtis's Bot. Mag.*, 182(1): tab. 755 (1978) - (En); Illus., col. illus. 3,4

Porter, D.M.
Nomenclatural changes in *Spilanthes* for the Galapagos Islands. *Madroño*, 25(1): 58-59 (1978). 4

Pustavoit, G.V. and Slyusar', E.L.
Ispol'zovanie dikikh vidov *Helianthus* v selektsii. *Byull. Vses. Ord. Lenina Inst. Rast. N.I. Vavilova*, 69: 11-19 (1977) - Chrom. nos. 1-7

Robinson, H.
Studies in the Heliantheae (Asteraceae): 9. Restoration of the genus *Alloispermum*. *Phytologia*, 38(5): 411-412 (1978). 4

Robinson, H.
Studies in the Heliantheae (Asteraceae): 10. The relationship of *Calea skutchii*. *Phytologia*, 38(5): 413-414 (1978). 4

Robinson, H.
Studies in the Heliantheae (Asteraceae): 11. A new genus *Kingianthus*. *Phytologia*, 38(5): 415-416 (1978). 4

Robinson, H.
Studies in the Heliantheae (Asteraceae): 12. Re-establishment of the genus *Smallanthus*. *Phytologia*, 39(1): 47-53 (1978) - Illus., chrom. nos. 4

Rock, B.N.
Wood anatomy of members of the subtribe *Espeletiinae* (Compositae). *IAWA Bull.*, no. 2-3: 49 (1978). 4

Tarasov, V.V.
Povtorna znakhidka adventyvnykh i karantynnykh roslyn *Salvia reflexa* Hornem. ta *Ambrosia trifida* L. v. URSR. (Repeated finding of adventitious and quarantine plants *Salvia reflexa* Hornem. and *Ambrosia trifida* L. in the Ukrainian SSR). *Ukr. Bot. Zhurn.*, 35(2): 188-189 (1978) - (En); Illus. 1

Turner, B.L.
Taxonomy of *Axiniphyllum* (Asteraceae - Heliantheae). *Madroño*, 25(1): 46-52 (1978) - Illus., map, keys. 4

Turner, B.L.
New species and combinations in the genera *Sigesbeckia* and *Trigonospermum* (Compositae: Melampodiinae). *Brittonia*, 30(1): 64-68 (1978) - Chrom. nos. 4

ANTHEMIDEAE

Androshchuk, A.F., Kostinenko,
L.D. and Khmel', N.V.
Vyvchennya kariotypiv u
predstavnykiv rodu Achillea L.
flory URSR. (Study of caryo-
types in representatives of
the genus Achillea L. of the
flora of the Ukrainian SSR).
Ukr. Bot. Zhurn., 35(3):
273-278 (1978) - (Rus, En);
1 Illus., maps, chrom. nos.

Arrigoni, P.V.
Le genre Santolina en Italie.
In OPTIMA Second Meeting,
Firenze (Italy), 23-29 May 1977.
Abstracts ...: [1]p. (1977).
1 Abstract only.

Bijok, K., Pawlak, T. and
Kreńska, B.
Embryological studies on
Anthemis tinctoria L. (Studia
embriologiczne nad Anthemis
tinctoria L.). Acta Soc. Bot.
Pol., 46(4): 547-557 (1977 publ.
1978) - (Pol); Illus., chrom.
1 nos.

Biste, C.
Zytotaxonomische Untersuchungen
des Formenkreises Achillea
millefolium (Asteraceae) in der
DDR. Feddes Repert., 88(9-10):
533-613 (1978) - (En); Illus.,
1 maps, chrom. nos., key.

Bohlmann, F. and Zdero, C.
Diterpenes with a new carbon
skeleton from Printzia laxa.
Phytochemistry, 17(3): 487-489
5 (1978).

Bohlmann, F. and Zdero, C.
New furanosesquiterpenes from
Eumorphia species. Phytochemistry,
17(7): 1155-1159 (1978). Gymno-
5 pentzia also.

Bremer, K.
Proposal (445) to change the
type species of Peyrousea DC.,
nom. cons. (Compositae). Taxon,
5 27(2/3): 305-306 (1978).

Greger, H.
Comparative phytochemistry and
systematics of Anacyclus. Biochem.
1,2 Syst. Ecol., 6(1): 11-17 (1978).

Illuminati, O. and Marchi, P.
Contribution to the biosystematic
knowledge of the genus Leucanthemum
(Compositae). In OPTIMA Second
Meeting, Firenze (Italy), 23-29 May
1977. Abstracts ...: [1]p. (1977).
1 Abstract only.

Issar, R.K.
Achillea millefolium Linn. -
floristic variability of morpho-
logical characters. (Achillea
millefolium Linn. - Blumene
Verämderlichkeit der morpho-
logischen Charakteren). Indian
Forester, 104(2): 90-93 (1978) -
1-7 (Hi, Ge, Fr); Illus.

Ling, Y. and Ling, Y.-R.
[Elachanthemum, genus novum
familiae Compositarum]. Acta
Phytotax. Sin., 16(1): 61-65 (1978)
2 - (Ch); Illus., key.

Shih, C.
(Ajaniopsis Shih, genus novum
familiae Compositarum sinensium).
Acta Phytotax. Sin., 16(2): 86-89
6 (1978) - (Ch); Illus.

Thompson, J.
Yarrow, herb of Achilles.
Vasculum, 63(2): 13 (1978).
1-7 Achillea millefolium.

SENECIONEAE

Barkley, T.M.
Three new species of Senecio
(Asteraceae) from Mexico.
Brittonia, 30(1): 69-75 (1978) -
4 Illus., chrom. nos.

Bohlmann, F., Ehlers, D. and
Zdero, C.
Einige neue Furanoeremophilane
aus Senecio - Arten. Phytochemistry,
5 17(3): 467-470 (1978) - (En).

Bohlmann, F. and Le Van, N.
Neue Sesqui- und Diterpene aus *Bedfordia salicina*. *Phytochemistry*, 17(7): 1173-1178 (1978) - (En). 7

Bohlmann, F. and Zdero, C.
Neue Furanoeremophilane und andere Sesquiterpene aus Vertretern der Gattung *Euryops*. *Phytochemistry*, 17(7): 1135-1153 (1978) - (En). 5

Bohlmann, F. and Zdero, C.
New furanoeremophilanes from South African *Senecio* species. *Phytochemistry*, 17(7): 1161-1164 (1978). 5

Bohlmann, F. and Zdero, C.
Hilliardinolester und andere Furanoeremophilane aus *Senecio mauricei*. *Phytochemistry*, 17(8): 1333-1335 (1978) - (En). 5

Correa, S. and Pippen, R.W.
The biology of *Pippenalia delphinifolia* (Compositae). *Bot. Notiser*, 131(1): 27-30 (1978) - Map. 4

Dickoré, W.B. and Adolphi, K.
Senecio inaequidens DC. im MTB 4908 Burscheid. *Göttinger Flor. Rundbr.*, 11(4): 98-99 (1977) - Illus. 1

Douglas, G.W. and Ruyle-Douglas, G.
Nomenclatural changes in the Asteraceae of British Columbia: 1. Senecioneae. *Canad. J. Bot.*, 56 (14): 1710-1711 (1978) - (Fr). *Arnica*, *Luina* and *Senecio*. 3

Gardinale, R. and Sciandra, A.
Nuova stazione di "*Senecio inaequidens*" nell' Italia Settentrionale. (A new station of "*Senecio inaequidens*" in Northern Italy). *Inform. Bot. Ital.*, 9(3): 290 (1977). 1

Koyama, H.
Notes on some species of Chinese *Cacalia*: 1. *Acta Phytotax Geobot.*, 53(5): 65-84 (1978) - (Ja, En); Illus. 2

Nordenstam, B.
Taxonomic studies in the tribe Senecioneae (Compositae). *Op. Bot.*, no. 44. 83p. (1978) - Illus., map. 1-7

Reichert, H.
Senecio jacobaea L. und *Senecio erucifolius* L. ergänzende Hinweise zur Unterscheidung der beiden Arten. *Göttinger Flor. Rundbr.*, 11(4): 102-109 (1977) - Illus., key. 1

Robinson, H.
Studies in the Senecioneae (Asteraceae): 8. A new species of *Psacalium* from Mexico. *Phytologia*, 38(4): 356-358 (1978) - Illus. 4

Robinson, H.
Studies in the Liabeae (Asteraceae): 12. A new species of *Munnozia* from Costa Rica. *Phytologia*, 39(5): 331-333 (1978) - Illus. 4

CALENDULEAE

Pandey, A.K. and Singh, R.P.
Development of seed and fruit in *Dimorphotheca sinuata* DC. *Flora* (Germany), 167(1): 57-64 (1978) - Illus. 5

CARDUEAE

Brullo, S.
Taxonomic and nomenclatural notes on the genera *Jasonia* Cass. and *Chiliadenus* Cass. (Compositae). In OPTIMA Second Meeting, Firenze (Italy), 23-29 May 1977. Abstracts ...: [1]p. (1977). Abstract only. 1

Cela Renzoni, G. and Viegi, L.
The "*Centaurea cineraria*" complex in Italy. In OPTIMA Second Meeting, Firenze (Italy), 23-29 May 1977. Abstracts ...: [1]p. (1977). Abstract only. 1

Gajić, M.R.
Die Variabilität der *Centaurea nervosa* Willd. Ihre neuen infraspezischen Formen: subsp. *josifovicii* und f. *sessilifolia*. *Bull. Acad. Serbe Sci. Arts. Sci. Math. Nat.*, 54(14): 13-19 (1976) - Illus. 1

Georgiadis, T. and Phitos, D.
Contribution à l'étude cytotaxonomique du genre *Centaurea* L. (sectio *Acrolophus* (Cass.) DC.) en Grèce. *Biol. Ecol. Medit.*, 3(1): 13-16 (1976) - (En); Chrom. nos. 1

Gremaud, M.
Contribution à la cytotaxonomie du genre *Carduus*. *Ber. Schweiz. Bot. Ges.*, 87(3/4): 173-181 (1977 publ. 1978) - (En, Ge); Illus., chrom. nos. 1,2

Kheradnam, M. and Bassiri, A.
Variations among heads, plants, and ecotypes of wild safflower. *J. Agric. Sci.*, 91(1): 223-228 (1978). 2

Kitamura, S.
La correspondance du Muséum national d'histoire naturelle, Paris. *Acta Phytotax Geobot.*, 53(5): 126-129 (1978) - (Ja); *Circium.* 2

Lovrić, A.-Z.
Evolution and ecology of Illyrian Centaureae: 2. Origin, biosystematics and morphogenesis in subgenus *Stoebe*. In OPTIMA Second Meeting, Firenze (Italy), 23-29 May 1977. Abstracts ...: [1]p. (1977) - Chrom. Nos. Abstract only. 1,2

Ninova, D.I.
Sravnitel'no-anatomicheskoe issledovanie vasil'kov Bolgarii: 2. List, stebel', listovoi sled. (Comparative - anatomical study of *Centaurea* spp. in Bulgaria: 2. Leaf, stem, leaf scar). *Bot. Zhurn.*, 63(3): 399-404 (1978) - Illus. 1

Ninova, D.I.
Sravnitel'no-anatomicheskoe issledovanie vasil'kov Bolgarii: 3. Ekologiya taksonomiya, filogeniya. (Comparative-anatomical study of *Centaurea* spp. in Bulgaria: 3. Ecology, taxonomy, phylogeny). *Bot. Zhurn.*, 63(4): 557-563 (1978) - Illus. 1

Mendez, B. and Wildpret, W.
Centaurea diluta Ait. nueva cita para la flora canaria. (*Centaurea diluta* Ait. new in the Canary Islands). *Vieraea*, 7(2): 133-136 (1978) - (En); Illus. 1

Shimisu, M.
On the corolla characters in Japanese species of Sect. *Saussurea*, genus *Saussurea* DC. (Compositae). *Bull. Nation. Sci. Mus., B* (Tokyo), 4(2): 83-92 (1978) - (Ja, En); Illus. 2

MUTISIEAE

Steyermark, J.A.
New taxa from Cerro Marahuaca, Venezuela. *Brittonia*, 30(1): 50-53 (1978) - Illus. *Duidaea marahuacensis*. 4

Turner, B.L.
A new species of *Acourtia* (Asteraceae - Mutisieae) from north central Oaxaca, Mexico. *Phytologia*, 38(6): 455 (1978). 4

Turner, B.L.
Taxonomic study of the scapiform species of *Acourtia* (Asteraceae - Mutisiieae). *Phytologia*, 38(6): 456-468 (1978) - Map, chrom. no., key. 3,4

LACTUCEAE

Bachmann, K. and Chambers, K.L.
Pappus part number in annual species of Microseris (Compositae, Cichoriaceae). Pl. Syst. Evol., 129(1-2): 119-134 (1978) - Illus.
3,4 American species only.

Barber, S.C. and Estes, J.R.
Comparative pollination ecology of Pyrrhopappus geiseri and Pyrrhopappus carolinianus. Amer. J. Bot., 65(5): 562-566 (1978) -
3 Illus., map.

Bjørndalen, J.E.
Aconitum septentrionale og Lactuca alpina som barskogsarter i Skien kommune, Telemark. (Aconitum septentrionale and Lactuca alpina in the coniferous forests of Skien, Telemark, SE Norway). Blyttia, 36(3): 125-134 (1978) - (En); Illus.,
1 maps.

Doll, R.
Zur Taraxacum - Flora der Kasachischen SSR. Feddes Repert., 88(9-10): 615-627 (1978) - (En); Illus., chrom.
2 no.

Doll, R.
Zur Taraxacum - Flores des Rila-Gebirges. Feddes Repert., 88(9-10): 629-643 (1978) -
1 (En); Illus., chrom. nos.

Duwensee, H.A.
Zu einem Fund con Lactuca virosa im Oberharz. Göttinger Flor. Rundbr., 12(2): 61-64
1 (1978) - Illus.

Gottlieb, L.D.
Stephanomeria malheurensis (Compositae), a new species from Oregon. Madroño, 25(1): 44-46 (1978) - Illus., chrom.
3 no.

Harborne, J.B.
The rare flavone isoetin as a yellow flower pigment in Heywoodiella oligocephala and in other Cichorieae. Phyto-
1 chemistry, 17(5): 915-917 (1978).

Kharkevich, S.S. and Tsvelev, N.N.
Novye vidy oduvanchika (Taraxacum Wigg.) iz severnoi chasti Kamchatskoi oblasti. (New species of dandelion (Taraxacum Wigg.) from the northern part of Kamchatka district). Bot. Zhurn., 63(6):
2 837-843 (1978) - Illus.

Lack, H.W.
Die Gattung Heywoodiella Svent. & Bramw. (Asteraceae, Lactuceae). (The genus Heywoodiella Svent. & Bramw. (Asteraceae, Lactuceae)). Willdenowia, 8(2): 329-339 (1978) - (En, Fr); Illus., map, chrom.
1 nos.

Lack, H.W.
Die Abbildungsvorlagen (Skizzen, Herbarbelege) zu Zahns Hieracium - Monographie. (The original drawings and specimens used by Zahn to illustrate his Hieracium monograph). Willdenowia, 8(2): 439-442 (1978).- (De Herbario Berolinensi Notulae no. 6) - (En);
1-7 Illus.

Retz, B. de
Contributions à la connaissance de la flore hiéraciologique de la France et de l'Espagne: 5. Taxons nouveaux pour le genre Hieracium dans les Pyrénées françaises et en Espagne. Bull. Soc. Bot. France,
1 125(3-4): 209-218 (1978) - (En).

Schnaeppi, H.
Über den Habitus von Urospermum dalechampii (Compositae). Ber. Schweiz. Bot. Ges., 87(3/4): 147-153 (1977 publ. 1978) - (Fr);
1 Illus.

New York Botanical Garden Library
3 5185 00288 3799

Schnedler, W.
Pflanzen, von denen in der mitteleuropäischen Literatur setten oder gar keine Abbildungen zu finden sind: Folge 4. 3: Cichorium endivia L. in Trifolium alexandrinum - Äckern. Göttinger Flor. Rundbr., 11(4): 96-97 (1977) - Illus. 1

Singh, D. and Kaul, V.
Cytoembryological studies on Indian Tragopogon L. Cytologia, 40(1): 35-44 (1975) - Illus. 6

Voss, E.G. and Böhlke, M.W.
The status of certain hawkweeds (Hieracium subgenus pilosella) in Michigan. Mich. Bot., 17(2): 35-47 (1978) - Maps, chrom. no., key. 3

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